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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

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Ex parte Courtney et al.

Appeal No. _______

Serial No.:	**09/704,102**
Filed:	**November 1, 2000**
Group Art Unit:	**2856**
Examiner:	**J. Saint Surin**
Applicant:	**Courtney et al.**
Title:	**DATA COLLECTOR INSTRUMENT WITH INTEGRAL SPEED SENSOR**

Cincinnati, Ohio 45202 December 16, 2002

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BRIEF ON APPEAL

This brief is in furtherance of Applicant's Notice of Appeal filed July 15, 2002, appealing the decision of the Examiner dated April 15, 2002 finally rejecting claims 1-24. A copy of the claims appears in the Appendix to this brief. This brief is transmitted in triplicate.

Real Party In Interest

The real party in interest in this appeal is Entek IRD International Corporation, a Corporation of Ohio having a place of business at 1700 Edison Drive, Milford, Ohio 45150.

Related Appeals and Interferences

There are no such appeals or interferences.

Status of Claims

Claims 1, 10, 12-13, 22 and 24 stand rejected under 35 U.S.C. § 102(e), asserted to be anticipated by Piety et al (U.S. Patent 6,078,874). Claims 2-9, 11-21 and 23 stand rejected under 35 U.S.C. §103(a), asserted to be unpatentable over Piety et al. in view of Van Voorhis (U.S. Patent 5,059,901).

Claims 1-24 were originally filed with the application. Applicant's Amendment of December 26, 2001 amended claims 1 and 13 to their present form.

Status of Amendments

There are no amendments pending.

Summary of Invention

This application relates to data collectors of the kind that are used in industrial environments to collect, for example, predictive maintenance data. In such applications, vibration data is collected from machines, and is then analyzed to identify signal patterns endemic of pending failures, such as from worn bearings.

The data collector of the present invention uses both a vibration sensor and an optical system, together, in collecting data. In one application of this system, noted at page 14, lines 14-19, the speed of rotation of a machine is optically measured by a laser tachometer (which detects speed of rotation from a reflective target on a rotating part of the machine passing through the laser beam), and simultaneously, vibration signals are collected, and both are stored by the data collector. In such an embodiment, the speed and vibration data may then be used, together, for predictive maintenance purposes, for example by performing an "order tracking" analysis of vibration data (normalizing vibration frequencies, based upon the speed of rotation of the machine).

In accordance with the recitations of the claims at issue here, a single data collector includes, in a common housing, the circuitry for receiving and digitizing a vibration signal, and an optical system, which can be used to simultaneously collect data in real time. Thus, for example, the operator may hold the housing containing the optical system with one hand,

directing the optical system to an appropriate point for rotational measurement, while simultaneously holding an accelerometer in the other hand. This is a very convenient mode of operation, and simplifies the apparatus that the operator must manipulate and carry during a data collection round.

Issues

Whether the subject matter of any of claims 1-24 is anticipated by or unpatentable in view of the Piety and Van Voorhis patents.

Grouping of Claims

The claims do not stand or fall together. Specifically, claims 8 and 20 each recite a rate of rotation measurement performed by an optical system, whereas claims 1 and 13 recite an optical system, without mention of the measurement performed. As noted below, the use of an optical system for a rate of rotation measurement, as opposed to any other measurement, is a separate point of distinction that lends separate patentability to claims 8 and 20.

Argument

For some time, data for predictive maintenance has been collected using portable data collectors, which typically include an accelerometer input for receiving vibration signals, analog/digital circuitry for converting such signals to a digital form for storage, and digital storage for storing the captured signals. Traditionally, the collected signal information is

carried in the collector to a host computer, typically a personal computer or workstation, in which the signals are uploaded from the collector and analyzed by software in the PC or workstation. In some more modern collectors, a processor, software and display are provided on the collector itself, to enable at least some field evaluation of the collected data.

The Canada patent cited in this application, U.S. Patent 5,870,699, illustrates one example of a data collector of this conventional variety. This collector, shown in Fig. 1, includes a microcomputer, display, analog/digital circuitry, and inputs and outputs for interacting with the user and collecting data. As would be expected of a device having such functionality, the collector, although portable, is fairly large -- about the same size as typical notebook computer. As stated in Canada at col. 5, lines 57-61:

> The height, width, and thickness dimensions of the analyzer 10 are 10.7" by 6.875" by 1.5" and it weighs approximately 4.25 pounds, including a battery.

The Piety patent cited by the Examiner, which is owned by the same company as the Canada patent and has a common inventor (Daniel G. Simpson) also describes a data collector system, centered around what is described as a handheld personal computer (HPC 32). The Piety patent illustrates (in its Fig. 1) the use of the HPC in obtaining vibration data. In that drawing, a technician is shown with the HPC 32 strapped to his belt, and holding a sensor unit 40 used to collect data. Multiple sensor units 40, usable with the base instrument, can be arrayed in the belt, as shown in Fig. 1 and discussed at col. 5, lines 7-10.

As noted by Piety, each sensor unit 40 includes either one or two sensors, which may be (col. 6, lines 19-38) vibration, movement, temperature, ultrasonic, voltage, current or flux sensors, or a bar code reader.

The Piety patent explains the use of a bar code reader at col. 6, lines 39-57 – the bar code reader can be used to optically read bar coded information from a bar code on a machine, including for example a machine identification, or machine set up information, or pre-stored measurement data. This data is read by the bar code reader and, for example, used to set up vibration or other measurements which occur subsequently.

Piety also discusses the use of a tachometer in measurements. Specifically, at col. 9 lines 39-40, Piety notes that measurements might involve "both a vibration sensor and a tachometer", and the "HPC 32 may prompt the sensor unit 40 to collect both types of machine operating characteristics, or the HPC 32 may prompt the sensor unit 40 to collect only one type of operating characteristic." This is elaborated later in col. 9, where the tachometer is identified as item 128 in Fig. 1, "mounted on or near the machine 12 and communicat[ing] wirelessly with the sensor unit 40." Applicant has not found any reference to indicate whether the tachometer is optical or uses another rotational speed sensing method.

Although the tachometer 128 may be used simultaneously with a vibration sensor, the bar code reader is not used in this way. The text in col. 6 of Piety clarifies that the "sensor unit 40 reads the information contained in the bar code 45 and transmits the information to the HPC 32. The HPC 32 determines from the bar code reading whether data should be taken, and if so, it further determines the type of data to be collected and the corresponding

measurement point(s). The HPC 32 transmits this information to the sensor unit 40 which then displays the information to the operator 18. The sensor unit 40 then acquires, processes, and transmits the requested data to the HPC 32." (Col 6, lines 53-62)

Collectively, what this text in Piety makes clear, is that the Piety system is a multi-unit system, and the intention is that the HPC 32 will be separate from the sensors it uses; the HPC 32 is strapped to the operator's belt, and communicates with several other units in separate housings to obtain data. The operator thus has many devices in separate housings to handle, and in a typical setup apparently holds at least the HPC 32 itself on his belt.

One possible reason for this approach, can be understood from the typical dimensions and weight cited in the Canada patent. A typical data collector, at 10.7" by 6.875" by 1.5" and 4.25 pounds, is not easy to hold in one hand or to manipulate manually.

Consider, for the moment, the hypothetical case where the bar code reader discussed by Piety, is mounted within the HPC, and the HPC has the size described by Canada. It would be difficult to manipulate the HPC and its incorporated optical system into position to read a bar code optically. For an analogy, consider attempting to read a bar code with a laser mounted in a typical notebook computer. It would probably be a two-hand operation. The operator would have to put down the accelerometer (or place it in a tool belt), then manipulate the HPC to the right position to read the bar code.

Next consider the challenge of reading optical information continuously, e.g., continuously targeting a laser on a rotating reflective target, as would be needed to use an optical system to generate tachometer readings, such as is recited in the present claims 8 and

20. Further consider that there is a simultaneous requirement to hold an accelerometer in contact with a machine being measured, to measure vibration signals. In this case, only one hand would be free to hold the HPC steady and aim the laser correctly to read tachometer information; the other hand is holding the accelerometer. The prospect of such an operation is not inviting.

This hypothetical may explain why the Piety system, while controlled by the HPC 32, uses sensors 40 separate from the HPC 32, in separate hand-holdable housings. In that way, the Piety system evades the inconveniences and difficulties obvious in the foregoing, by simply avoiding placement of sensors inside the HPC 32 itself.

Present claim 1, and therefore all of claims 1-12, recites a data collector having:

> a housing,
> a vibration signal input on said housing,
> an analog to digital converter within said housing connected to said vibration signal input, converting a vibration signal received at said vibration signal input to a digitized vibration signal,
> an optical system within said housing, said optical system receiving light from outside said housing,
> a receiver circuit converting said received light to a digital signal, and
> a digital signal processing circuit connected to said analog to digital converter and said receiver circuit, and receiving, storing or processing said digitized vibration signal and said digital signal converted from said received light, in real time, for the purpose of predictive maintenance.

Notable in this language, is the recitation of a housing that contains an "optical system" that "receiv[es] light from outside [the] housing", and also contains an "analog to

digital converter" and "digital signal processing circuit" for a "vibration signal". Claim 1 also recites that the "vibration signal" <u>and</u> the "signal converted from [] received light" are received, stored or processed in "real time". The claim thus clearly recites an integrated system that operates the optical system and vibration signal processing simultaneously; the optical system is inside the housing, as is the circuitry that digitizes and processes the vibration signal, and signals from both are received, stored or processed in real time.

Present claim 13, and therefore all of claims 13-24, recites a method including:

> receiving a vibration signal into a housing of said data collector, and converting said a vibration signal to a digitized vibration signal within said housing,
>
> receiving light from outside said housing into said housing, and converting said received light to a digital signal, and
>
> simultaneously receiving, storing or processing said digitized vibration signal and said digital signal converted from said received light.

Notable in this language, is the recitation that light is received "into [a] housing", which housing also receives a "vibration signal" and "convert[s] the signal to a digitized vibration signal within [the] housing". Claim 13 also recites that the "vibration signal" <u>and</u> the "signal converted from [] received light" are received, stored or processed "simultaneously". Thus, again, the claim clearly recites an integrated system that operates an optical system and vibration signal processing simultaneously; the optical system is inside a housing, as is the circuitry that digitizes and processes the vibration signal, and signals from both are received, stored or processed simultaneously.

These claims are notably distinct from Piety.

Initially, it should be noted that the only optical system clearly referenced by Piety, is the bar code reader. As made clear by the text quoted above, however, the bar code reader is not used simultaneously with any other sensors, but rather is used only as a precursor to collecting signals with another sensor. Moreover, the bar code signal is processed in the HPC 32, but the optical system of the bar code reader is not in the HPC 32, but rather is in the separate housing of a sensor unit 40, in communication with HPC 32. Indeed, as noted above, there is reason to believe that Piety would avoid a structure in which the optical system is in the same housing as the HPC 32.

Furthermore, the "tachometer" described in Piety at col. 9, which may or may not be an optical system, is again not within the same housing as a vibration sensor. Rather, it is a separate device, as shown in Fig. 1. The tachometer communicates wirelessly to sensor units 40 and/or HPC 32. Thus, again, there is no optical system in the same housing in which vibration signals are digitized and/or processed.

The Examiner's final rejection asserts that Piety "clearly discloses" a sensor unit 40 having both a vibration sensor and a tachometer. Applicant disagrees for multiple reasons.

First, Applicant notes that the tachometer described by Piety is not necessarily an optical system, as recited in the claims at issue. Thus, even were the Examiner correct, the language of the claims would not be met.

Furthermore, Applicant notes that the Piety tachometer is illustrated in Fig. 1 as a separate device from the housing of the sensor unit 40. This does not support the Examiner's

theory that a single sensor unit housing 40 would contain a tachometer as well as a vibration sensor.

Notwithstanding the disclosure of a separate tachometer in Piety, the Examiner appears to interpret a single phrase at col. 9, lines 39-40, to imply a single sensor unit housing which contains both an optical tachometer and vibration sensor, as opposed to a sensor unit 40 that can obtain readings from a vibration sensor and a tachometer. Applicant submits this reading is inappropriate, not only because a separate tachometer is explicitly disclosed, but also because the combined sensor unit the Examiner proposes would be unworkable.

A sensor unit 40 containing a vibration sensor, must be held against the machine being measured, to obtain proper vibration signals. A laser tachometer, to obtain proper rotation speed signals, must be aimed properly to pick up the rotating target. One sensor unit 40 having both an accelerometer and laser tachometer, as the Examiner has suggested, would be very difficult to position to simultaneously perform both of these functions. A separate tachometer, delivering signals by wireless transmission, as is disclosed by Piety, would not have these problems. Indeed, a non-optical tachometer might not have these problems either.

Thus, Applicant submits, the Examiner's assertion of a motivation to combine the accelerometer with an optical tachometer in the same sensor unit 40, flies in the face of this clear and substantial drawback, and is contrary to the disclosure of Piety, which shows an accelerometer in a housing separate from the tachometer.

In this regard, Applicant notes the same issue is raised by the Examiner's rejection based on Van Voorhis. This rejection is based upon the disclosure in Van Voorhis of a laser

light tachometer. The Examiner asserts that it would be obvious to use a laser light tachometer, from Van Voorhis, in the system of Piety. Presumbly, the Examiner would place the laser light tachometer into the sensor unit 40 shown by Piety, in place of the bar code reader used by Piety.

This approach would, again, create a device that is very difficult to use, as it would have to be positioned to simultaneously pick up vibration signals and target a laser onto a reflective target. This is not a likely approach to take in combining the technology of Piety and Van Voorhis.

Instead, Applicant submits that combining Van Voorhis with Piety, if motivated at all, would simply lead to the use of an optical tachometer in the separate location identified as 128 in Piety's Fig. 1. That would not involve the difficulties inherent in trying to combine the optical tachometer and vibration sensor in the same housing.

In summary, Applicant submits that the Examiner's rejection is in error, for the reason that Piety does not disclose an optical system that is in the same housing as a vibration sensor and used simultaneously with it. At best, Piety shows an optical bar code reader that is in the same housing as a vibration sensor, but is used at different times. Applicant further submits that there is nothing in Piety to suggest a tachometer in the same housing as a vibration sensor; Piety shows a tachometer that is clearly separate from other sensors, and contrary to the Examiner's supposition, an optical tachometer cannot be readily used in the same housing as a vibration sensor. Finally, Applicant submits that the disclosure of an optical tachometer

in Van Voorhis does nothing to meet these deficiencies in Piety, and merely would suggest using an optical tachometer in the separate location disclosed by Piety.

Applicant thus respectfully requests a reversal of all rejections and allowance of the claims.

Respectfully submitted,
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APPENDIX

1. A data collector, comprising

a housing,

a vibration signal input on said housing,

an analog to digital converter within said housing connected to said vibration signal input, converting a vibration signal received at said vibration signal input to a digitized vibration signal,

an optical system within said housing, said optical system receiving light from outside said housing,

a receiver circuit converting said received light to a digital signal, and

a digital signal processing circuit connected to said analog to digital converter and said receiver circuit, and receiving, storing or processing said digitized vibration signal and said digital signal converted from said received light, in real time, for the purpose of predictive maintenance.

2. The data collector of claim 1 wherein said optical system further comprises a light source emitting light through an aperture in said housing for reflection and return to said optical system.

3. The data collector of claim 2 wherein said light source comprises a laser light source.

4. The data collector of claim 3 wherein said laser light source comprises a laser diode and a collimating lens, said collimating lens collimating diverging light from said laser diode to a collimated light beam emitted from said housing.

5. The data collector of claim 2 wherein said receiver circuit comprises a light detector for detecting reflected light, and said optical system further comprises a beam splitter positioned to direct reflected light received through said aperture to light detector, said beam splitter positioned between said light source and said aperture.

6. The data collector of claim 1 wherein said receiver circuit comprises a PIN diode for converting received light to an electrical signal.

7. The data collector of claim 6 wherein said receiver further comprises a threshold comparator for comparing current flow in said PIN diode to a threshold, and producing a digital signal to said digital signal processing circuit when said threshold is exceeded.

8. The data collector of claim 7 wherein said digital signal processing circuit computes a rate of rotation of a moving element in response to timing of said digital signal from said threshold comparator, whereby said optical system is usable as a laser tachometer.

9. The data collector of claim 6 wherein said optical system further comprises a filter positioned between said aperture and said PIN diode, said filter filtering light other than at a wavelength of said light source.

10. The data collector of claim 1 further comprising a storage device, said digital signal processing circuit storing said digitized vibration signal in said storage device.

11. The data collector of claim 2 further comprising a display and input keys, said digital signal processing circuit displaying operational information on said display and receiving operational instructions from an operator via said input keys.

12. The data collector of claim 1 wherein said housing is sized to fit in a single hand of an operator.

13. A method of collecting data for the purpose of predictive maintenance using a data collector, comprising

receiving a vibration signal into a housing of said data collector, and converting said a vibration signal to a digitized vibration signal withing said housing,

receiving light from outside said housing into said housing, and converting said received light to a digital signal, and

simultaneously receiving, storing or processing said digitized vibration signal and said digital signal converted from said received light.

14. The method of claim 13 further comprising generating light within said housing and emitting said light through an aperture in said housing for reflection and return.

15. The method of claim 14 wherein said light comprises laser light.

16. The method of claim 15 wherein said laser is generated by a laser diode and a collimating lens, said collimating lens collimating diverging light from said laser diode to a collimated light beam emitted from said housing.

17. The method of claim 14 wherein said light is received by a light detector for detecting reflected light, and further comprising positioning a beam splitter to direct reflected light received through an aperture in said housing to said light detector, said beam splitter positioned between said light source and said aperture.

18. The method of claim 13 wherein said light is received by a PIN diode and converted thereby to an electrical signal.

19. The method of claim 18 further comprising comparing current flow in said PIN diode to a threshold, and producing a digital signal when said threshold is exceeded.

20. The method of claim 19 further comprising computing a rate of rotation of a moving element in response to timing of said digital signal resulting from said threshold comparison.

21. The method of claim 18 further comprising positioning a filter between said aperture and said PIN diode, said filter filtering light other than at a wavelength of said light source.

22. The method of claim 13 further comprising storing said digitized vibration signal in a storage device.

23. The method of claim 14 further comprising displaying operational information on a display on said housing, and receiving operational instructions from an operator via input keys on said housing.

24. The method of claim 13 wherein said housing is sized to fit in a single hand of an operator.